

CLAIMS:

1. A process for producing an aromatic polyimide foam, which process comprises:
 - (a) providing a first solution comprising one or more aromatic dianhydrides or derivatives of aromatic dianhydrides dissolved in one or more polar solvents, along with an effective amount of one or more blowing agents;
 - (b) providing a second solution comprising one or more isocyanates;
 - (c) mixing the first and second solutions at ambient temperature to produce an admixture;
 - (d) allowing the admixture to foam to completion under ambient conditions to produce a foamed product; and
 - (e) curing the foamed product.
2. The process of claim 1, wherein step (e) comprises exposing the foamed product to high frequency electromagnetic radiation, whereby the foamed product is cured from the inside thereof outwardly, allowing evolution of volatiles from interior areas of the foamed product, instead of entrapment of the volatiles therein by an outer rind.
3. The process of claim 2, additionally comprising exposure to thermal energy to finalize cure.
4. The process of claim 1, wherein step (e) comprises exposing the foamed product to thermal energy.
5. The process of claim 1, wherein the first solution of step (a) additionally comprises an effective amount of one or more aromatic diamines.
6. The process of claim 1, which comprises the following additional step:
 - (f) post curing the cured foamed product by exposing the cured foamed product to thermal energy, whereby the cured foamed product is post cured from the outside thereof inwardly.

7. The process of claim 1, wherein the first solution of step (a) additionally comprises an effective amount of one or more catalysts.

5 8. The process of claim 7, wherein the one or more catalysts is one or more members selected from the group consisting of amine based catalyst and metallic based catalyst.

9. The process of claim 1, wherein the first solution of step (a) additionally comprises an effective amount of one or more surfactants.

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10. The process of claim 1, wherein the first solution of step (a) additionally comprises an effective amount of one or more fire retardants.

11. The process of claim 1, wherein the one or more aromatic dianhydrides is one or more
15 members selected from the group consisting of pyromellitic dianhydride; 3, 3', 4, 4'-
bezophenone tetracarboxylic dianhydride; 4, 4'-oxydiphthalic anhydride; and 3, 3', 4, 4'
biphenyl tetracarboxylic dianhydride.

12. The process of claim 1, wherein the one or more polar solvents is one or more members
20 selected from the group consisting of N, N-dimethylformamide; N, N-dimethylacetamide; and
N-methylpyrrolidinone.

13. The process of claim 1, wherein the one or more blowing agents is one or more members
selected from the group consisting of water, methanol, ethanol, acetone, 2-butoxyethanol, ethyl
25 glycol butyl ether, ethylene glycol, halogen substituted organic compound, and ether.

14. The process of claim 13, wherein the halogen substituted organic compound is a member
selected from the group consisting of HCFC-141-B and HFC-245FA.

15. The process of claim 13, wherein the ether is a member selected from the group consisting of tetrahydrofuran.

16. The process of claim 1, wherein the one or more isocyanates is one or more members
5 selected from the group consisting of monomeric organic isocyanate, polymeric organic isocyanate, and inorganic isocyanate.

17. The process of claim 8, wherein the amine based catalyst is selected from the group
10 consisting of Polycat 33, Polycat 5, Polycat BL 22, Polycat LV 33, Polycat 18, Dabco 8154 and Niax A-33.

18. The process of claim 8, wherein the metallic based catalyst is selected from the group consisting of Dabco K-15.

15 19. The process of claim 9, wherein the one or more surfactants is one or more members selected from the group consisting of DC 193, DC 195, DC 197, DC 198, DC 5000, DC 5598, Niax L620 and Niax L-6900.

20. The process of claim 1, wherein the one or more isocyanates is one or more members
20 selected from the group consisting of Rubinate M, Rubinate TDI, toluene diisocyanate, methylene diisocyanate, Papi 94, and Papi 27.

21. The process of claim 1, wherein the one or more aromatic diamines is one or more
members selected from the group consisting of 4, 4' oxydianline; 3, 4' oxydianline; m-
25 phenylenediamine; p-phenylenediamine; 1,3 bis(3-aminophenoxy)benzene; 4,4' diaminobenzophenone; and 4,4' diaminodiphenylsulphone.

22. The process of claim 10, wherein the one or more fire retardants is one or more members selected from the group consisting of Antiblaze N, Antiblaze 80, and Vircol 82.

23. The process of claim 1, wherein the first solution of step (a) comprises: one or more aromatic dianhydrides which is one or more members selected from the group consisting of pyromellitic dianhydride; 3, 3', 4, 4'- bezophenone tetracarboxylic dianhydride; 4, 4'- oxydiphthalic anhydride; and 3, 3', 4, 4' biphenyl tetracarboxylic dianhydride;

5 one or more polar solvents which is one or more members selected from the group consisting of N, N-dimethylformamide; N-N-dimethylacetamide; and N-methylpyrrolidinone; an effective amount of one or more blowing agents, which is one or more members selected from the group consisting of water, methanol, ethanol, acetone, 2-butoxyethanol, ethyl glycol butyl ether, ethylene glycol, HCFC-141-B, HFC-245FA, and tetrahydrofuran ; an effective amount of one or
10 more catalysts, which is one or more members selected from the group consisting of amine based catalysts and metallic based catalysts; an effective amount of one or more surfactants; and an effective amount of one or more fire retardants; and the second solution of step (b) comprises one or more isocyanates which is one or more members selected from the group consisting of monomeric organic isocyanates, polymeric organic isocyanates, and inorganic isocyanates.

15 24. The process of claim 1, wherein the first solution of step (a) comprises: one or more aromatic dianhydrides which is one or more members selected from the group consisting of pyromellitic dianhydride; 3, 3', 4, 4'- bezophenone tetracarboxylic dianhydride; 4, 4'- oxydiphthalic anhydride; and 3, 3', 4, 4' biphenyl tetracarboxylic dianhydride; one or more
20 aromatic diamines which is one or more members selected from the group consisting of 4, 4' oxydianiline; 3, 4' oxydianiline; m-phenylenediamine; p-phenylenediamine; 1,3 bis(3-aminophenoxy)benzene; 4,4' diaminobenzophenone; and 4,4' diaminodiphenylsulphone; one or more polar solvents which is one or more members selected from the group consisting of N, N-dimethylformamide; N-N-dimethylacetamide; and N-methylpyrrolidinone; an effective amount
25 of one or more blowing agents, which is one or more members selected from the group consisting of water, methanol, ethanol, acetone, 2-butoxyethanol, ethyl glycol butyl ether, ethylene glycol, HCFC-141-B, HFC-245FA, and tetrahydrofuran ; an effective amount of one or more catalysts, which is one or more members selected from the group consisting of amine based catalysts and metallic based catalysts; an effective amount of one or more surfactants; and an

effective amount of one or more fire retardants; and the second solution of step (b) comprises one or more isocyanates which is one or more members selected from the group consisting of monomeric organic isocyanates, polymeric organic isocyanates, and inorganic isocyanates.

5 25. The process of claim 1, wherein the first and second solutions are thoroughly combined by stirring with a high speed mixer.

26. The process of claim 6, wherein the first and second solutions are thoroughly combined by stirring with a high speed mixer.

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27. The process of claim 23, wherein the first and second solutions are thoroughly combined by stirring with a high speed mixer for about 5-20 seconds.

15 28. The process of claim 24, wherein the first and second solutions are thoroughly combined by stirring with a high speed mixer for about 5-20 seconds.

29. The process of claim 25, wherein the foamed product is cured in step (e) by exposing the foamed product to microwave radiation.

20 30. The process of claim 26, wherein the foamed product is cured in step (e) by exposing the foamed product to microwave radiation.

31. The process of claim 27, wherein the foamed product is cured in step (e) by exposing the foamed product to microwave radiation.

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32. The process of claim 1, wherein the admixture from step (c) is allowed to foam to completion in an open container in step (d).

33. The process of claim 1, wherein the admixture from step (c) is immediately transferred to a closed mold, wherein it is allowed to foam to completion in step (d), whereupon the foamed product is removed from the mold, and the foamed product is then cured by exposure to microwave radiation in step (e).

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34. The process of claim 1, wherein the first and second solutions are mixed in step (c) in air within a mixing chamber of a spraying system, into which mixing chamber the first and second solutions are individually fed, whereupon the resulting admixture of step (c) is sprayed by the spraying system onto the surface of an article, upon which it is allowed to foam to completion in step (d).

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35. The process of claim 1, wherein the first and second solutions are mixed in step (c) in air within a high speed mixer, into which mixer the first and second solutions are individually fed, whereupon the resulting admixture of step (c) is extruded onto the surface of an article, upon which it is allowed to foam to completion in step (d).

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36. An aromatic polyimide foam comprising one or more aromatic dianhydrides, one or more aromatic diamines, and one or more isocyanates.

37. The aromatic polyimide foam of claim 36, wherein the weight percentage of aromatic dianhydride is from about 30% to about 80%, the weight percentage of aromatic diamine is from about 0.5% to about 15%, and the weight percentage of isocyanate is from about 10% to about 50%.

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38. The aromatic polyimide foam of claim 36, wherein the one or more aromatic diamines is one or more members selected from the group consisting of 4, 4' oxydianiline; 3, 4' oxydianiline; m-phenylenediamine; p-phenylenediamine; 1,3 bis(3-aminophenoxy)benzene; 4,4' diaminobenzophenone; and 4,4' diaminodiphenylsulphone.

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39. The aromatic polyimide foam of claim 36, wherein the one or more aromatic dianhydrides is one or more members selected from the group consisting of pyromellitic dianhydride; 3, 3', 4, 4'- bezophenone tetracarboxylic dianhydride; 4, 4'-oxydiphthalic anhydride; and 3, 3', 4, 4' biphenyl tetracarboxylic dianhydride.

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40. The aromatic polyimide foam of claim 36, wherein the one or more isocyanates is one or more members selected from the group consisting of monomeric organic isocyanates, polymeric organic isocyanates, and inorganic isocyanates.

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41. The aromatic polyimide foam of claim 36, wherein the one or more isocyanates is one or more members selected from the group consisting of Rubinate M, Rubinate TDI, toluene diisocyanate, methylene diisocyanate, Papi 94, and Papi 27.

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42. The aromatic polyimide foam of claim 36, having a density of from about .2 pounds/ft³ to about 20 pounds/ft³, wherein the expansion of the polyimide foam is restrained while foaming.

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43. The aromatic polyimide foam of claim 36, having a density of from about .2 pounds/ft³ to about 1 pounds/ft³, wherein the aromatic polyimide foam is allowed to freely expand while foaming.

44. The aromatic polyimide foam of claim 36, additionally comprising one or more catalysts.

45. The aromatic polyimide foam of claim 44, wherein the one or more catalysts is one or more members selected from the group consisting of amine based catalysts and metallic based catalysts.

46. The aromatic polyimide foam of claim 45, wherein the amine based catalyst is selected from the group consisting of Polycat 33, Polycat 5, Polycat BL 22, Polycat LV 33, Polycat 18, Dabco 8154 and Niax A-33.

47. The aromatic polyimide foam of claim 45, wherein the metallic based catalyst is selected from the group consisting of Dabco K-15.

48. The aromatic polyimide foam of claim 36, additionally comprising one or more surfactants.

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49. The aromatic foam of claim 48, wherein the one or more surfactants is one or more members selected from the group consisting of DC 193, DC 195, DC 197, DC 198, DC 5000, DC 5598, Niax L620 and Niax L-6900.

10 50. The aromatic polyimide foam of claim 36, additionally comprising one or more fire retardants.

51. The aromatic polyimide foam of claim 50, wherein the one or more fire retardants is one or more members selected from the group consisting of Antiblaze N, Antiblaze 80 and Vircol 82.

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52. The aromatic polyimide foam of claim 36, additionally comprising one or more polar solvents.

53. The aromatic polyimide foam of claim 52, wherein the one or more polar solvents is one or
20 more members selected from the group consisting of N, N-dimethylformamide; N, N-dimethylacetamide; and N-methylpyrrolidinone.

54. The aromatic polyimide foam of claim 36, additionally comprising one or more blowing agents.

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55. The aromatic polyimide foam of claim 54, wherein the one or more blowing agents is one or more members selected from the group consisting of water, methanol, ethanol, acetone, 2-butoxyethanol, ethyl glycol butyl ether, ethylene glycol, halogen substituted organic compound, and ether.

56. The aromatic polyimide foam of claim 55, wherein the halogen substituted organic compound is a member selected from the group consisting of HCFC-141-B and HFC-245FA.

57. The aromatic polyimide foam of claim 55, wherein the ether is a member selected from the
5 group consisting of tetrahydrofuran.